ON THE QUESTION OF TIMBRE (TONE QUALITY) DETERMINATION

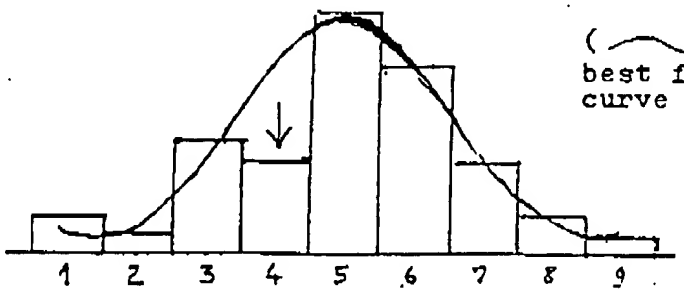
Inventor's patent application does much more than a "simple" modelling; in particular, special attention is paid not only to the frequencies, but to the waveforms of the corresponding sounds. Those waveforms are computed using a scale invariance property which amounts to say that a melody is a "development" of a given timbre of sound; the corresponding process can be applied to simple man-composed melodies, thereby enabling one to evaluate simply its effect and relevance to deduce a timbre from a given melody.

In order to provide a simple understanding of how this process works, I shall give a few examples from well-known tunes; this will detail in each case, the content of the memory (memory A in patent application). Consider the song "We shall overcome": writing 1 for the tonic, 2 for the second, 3 for the third, 4 the fourth, 5 the fifth, 6 the sixth, 7 the seventh, 8 the octave and 9 the ninth, the sequence of notes goes

5566543 (twice repeated)55678976765 67876543 6543 3554321.

This is the sequence to be stored in memory A. Next, we count how many times each note is used, and trace the corresponding diagram:

note	1	2	3	4	5	6	7	8	9	(in abscissa below)
nb of times	2	1	6	5	13	10	5	2	1	(in ordinate below)
smallest harmonics	1	9	5	4	3	5	15	2	9	
		8	4	3	2	3	8	1	4	



(~ : best fit of curve of eq. 1)

Comparing then with the curve of eq. 1, there is an obvious lack at the fourth: the corresponding "smallest harmonics" are harmonics 3 and 4 (the fourth being equal to or very next to 4/3 depending of temperament used); there is also a slight lack at the second (harmonics 8 and 9) and a slight excess at the tonic (harmonic 1). The resulting sound will, therefore, mainly be composed of the first two harmonics, with the first one even slightly enhanced. Comparing with the harmonic structures from a pre-selected panel of timbres such as below (taken from "Casio SK1" manual) will therefore select the timbre "organ", as is fitted for "We shall overcome".

	Harmonic number	1	2	3	4	6	8	10	12	16
Timbre	Vibraphone					1		2	3	
	Organ	5	3							
	Harpsichord		1	1	1		2	2	2	2
	Violin	1	1		1	1	2	2	2	2
	Clarinet	4	1	3						

and so on, where the numbers in regard of harmonic number are proportional to the amplitude of corresponding harmonic.

Although we do not mean to say that every piece of music should be played with the computed timbre, the examples given here illustrate the functioning of the underlying physical law which applies -- at least as an approximation -- in the case of the particles waveform: the impression one may get that "we shall overcome" is to be played on an organ rather than a harpsichord for instance, is indeed related to the set of frequencies used in this tune. Similarly, the prevalence of thirds in lullabies and of fourths in military marches implies different kinds of instruments to interpret them. Thus if one considers the yiddish lullaby "Yankele", written by M. Gebirtig, the same process as before yields (writing -2, -3... for a second, athird... below the tonic):

note	-4	-3	-2	1	2	3	4	5	6	7	8
nb of times	1	0	0	13	4	17	16	13	1	1	0
harmonics	1	5	8	1	9	6	4	3	5	16	
	2	6	9-		8	5	3	2	3	9	

Enhancement of the first, second, fourth and sixth harmonics, and diminution of third and fifth will yield something similar to a violin with a damper. Here, it is to be noted that the center of the global repartition is on the (minor) third. In all these cases, the process of claims 41 and 43 has simply been applied. Of course, use of exact harmonic intervals enhances the relevance and effectiv ness of this process: this in turn implies the use of the keyboard described in claim 36 and represented in Fig. 4.